

What is claimed is:

1. A steam reformer for converting a fuel into a reformat stream comprising hydrogen, said reformer comprising a closed vessel and a burner disposed within said vessel, said burner

5 comprising:

(a) a start fuel manifold for receiving and distributing a start fuel stream;

(b) an oxidant manifold for receiving and distributing an oxidant stream, said oxidant manifold having a plurality of oxidant distribution tubes, each of said oxidant distribution tubes having an inlet end and an outlet end, said oxidant distribution tubes disposed in a separator member; and

(c) a burner fuel manifold for receiving and distributing a burner fuel stream, said burner fuel manifold comprising a plurality of burner fuel distribution tubes, each of said burner fuel distribution tubes having an inlet end and an outlet end, said burner fuel distribution tubes extending through said start fuel manifold and said oxidant manifold and fluidly isolated therefrom,

wherein said outlet end of each of said plurality of burner fuel distribution tubes extends into said

inlet end of one of said oxidant distribution
tubes, forming a gap between the outer wall of said
30 burner fuel distribution tube and the inner wall of
said oxidant distribution tube, and said start fuel
manifold has one or more openings therein
associated with at least a portion of said burner
fuel distribution tubes.

2. A steam reformer for converting a fuel
into a reformat stream comprising hydrogen, said
reformer comprising a closed vessel and a burner
disposed within said vessel, said burner
5 comprising:

- (a) a burner fuel manifold for receiving and
distributing a burner fuel stream, said
burner fuel manifold having a plurality
of burner fuel distribution tubes, each
10 of said burner fuel distribution tubes
having an inlet end and an outlet end,
said burner fuel distribution tubes
disposed in a separator member;
- (b) an oxidant manifold for receiving and
15 distributing an oxidant stream, said
oxidant manifold comprising a plurality
of oxidant distribution tubes, each of
said oxidant distribution tubes having an
inlet end and an outlet end, said oxidant
20 distribution tubes extending through said
burner fuel manifold and fluidly isolated
therefrom; and

(c) a start fuel manifold for receiving and
distributing a start fuel stream, said
25 start fuel manifold comprising a
plurality of start fuel distribution
tubes, each of said start fuel
distribution tubes having an inlet end
and an outlet end, said start fuel
30 distribution tubes extending through said
oxidant manifold and fluidly isolated
therefrom,

wherein said outlet end of each of said plurality
of oxidant distribution tubes extends into said
35 inlet end of one of said burner fuel distribution
tubes, forming a first gap between the outer wall
of said oxidant distribution tube and the inner
wall of said burner fuel distribution tube, and
said outlet end of each of said start fuel
40 distribution tubes extends into said inlet end of a
corresponding one of said oxidant distribution
tubes, forming a second gap between the outer wall
of said start fuel distribution tube and the inner
wall of said oxidant distribution tube.

3. The reformer of claim 1 wherein said
plurality of burner fuel distribution tubes and
said plurality of oxidant distribution tubes are
arranged in a hexagonal array.

4. The reformer of claim 1 wherein the gaps
formed between said burner fuel distribution tubes

and said oxidant distribution tubes are annular gaps.

5 5. The reformer of claim 1 wherein said openings in said start fuel manifold comprise one or more discrete openings distributed around the circumference of at least a portion of said burner fuel distribution tubes.

6. The reformer of claim 5 wherein said openings are asymmetrically distributed around the circumference of each of said burner fuel distribution tubes.

7. The reformer of claim 1 wherein at least a portion of said burner fuel distribution tubes extend through and correspond to said openings in said start fuel manifold, forming at least one gap
5 between the outer wall of each of said burner fuel distribution tubes and corresponding said opening.

8. The reformer of claim 7 wherein said gaps between the outer walls of said burner fuel distribution tubes and corresponding said openings are annular gaps.

9. The reformer of claim 7 wherein said at least one gap between at least a portion said burner fuel distribution tubes and corresponding

said openings of said start fuel manifold comprises
5 a plurality of gaps.

10. The reformer of claim 9 wherein said gaps
between at least a portion of said burner fuel
distribution tubes and corresponding said openings
of said start fuel manifold are asymmetrically
5 distributed around the circumference of each of
said burner fuel distribution tubes.

11. The reformer of claim 1 wherein said
separator member comprises insulating material.

12. The reformer of claim 11 wherein said
insulating material comprises a ceramic.

13. The reformer of claim 1, further
comprising a plurality of substantially cylindrical
reformer tubes disposed within said vessel, each of
said reformer tubes comprising an outer tube, a
5 substantially concentric inner gas return tube, and
an annular catalyst bed defined by the volume
between said outer tube and said inner gas return
tube.

10 14. The reformer of claim 13 wherein said
catalyst bed comprises catalyst pellets.

15. The reformer of claim 13 wherein said
catalyst bed comprises a foam support.

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16. The reformer of claim 13 wherein said catalyst bed comprises a metal foam support.

17. The reformer of claim 16 wherein said
20 metal foam support comprises a FeCrAlY alloy.

18. The reformer of claim 13 wherein said reformer tubes further comprise at least one stabilizer member connected to said inner gas return tube and interposed between said outer tube
5 and said inner gas return tube.

19. The reformer of claim 18 wherein said at least one stabilizer member comprises at least one annular perforated plate extending radially from said inner gas return tube.

20. The reformer of claim 18 wherein said at least one stabilizer member comprises at least one fin extending axially from said inner gas return tube.

21. The reformer of claim 13, further comprising a vaporizer disposed within said vessel for receiving and vaporizing a stream comprising water.

22. The reformer of claim 21 wherein said vaporizer comprises a finned tube helical coil.

23. The reformer of claim 21 wherein said vaporizer comprises a corrugated tube helical coil.

24. A steam reformer for converting a fuel into a reformat stream comprising hydrogen, said reformer comprising:

- (a) a closed vessel;
- 5 (b) a plenum disposed within said vessel for receiving said reformat, said plenum having a floor plate;
- (c) a bottom pan disposed within said plenum, said bottom pan substantially in the
10 shape of an inverted bowl and having at least one hole therein; and
- (d) a reformat outlet extending from said floor plate into said plenum in the
15 region defined by the cooperating surfaces of said bottom pan and said floor plate.

25. The reformer of claim 24, further comprising a plurality of substantially cylindrical reformer tubes disposed within said vessel, each of said reformer tubes comprising an outer tube, a
5 substantially concentric inner gas return tube, and an annular catalyst bed defined by the volume between said outer tube and said inner gas return tube.

10 26. The reformer of claim 25 wherein said
catalyst bed comprises catalyst pellets.

 27. The reformer of claim 25 wherein said
catalyst bed comprises a foam support.

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 28. The reformer of claim 25 wherein said
catalyst bed comprises a metal foam support.

 29. The reformer of claim 28 wherein said
20 metal foam support comprises a FeCrAlY alloy.

 30. The reformer of claim 25 wherein said
reformer tubes further comprise at least one
stabilizer member connected to said inner gas
return tube and interposed between said outer tube
5 and said inner gas return tube.

 31. The reformer of claim 30 wherein said at
least one stabilizer member comprises at least one
annular perforated plate extending radially from
said inner gas return tube.

 32. The reformer of claim 30 wherein said at
least one stabilizer member comprises at least one
fin extending axially from said inner gas return
tube.

 33. The reformer of claim 1, further
comprising:

5 a plurality of substantially cylindrical reformer tubes disposed within said vessel, each of said reformer tubes comprising an outer tube, a substantially concentric inner gas return tube, and an annular catalyst bed defined by the volume between said outer tube and said inner gas return tube;

10 a plenum disposed within said vessel for receiving said reformat, said plenum having a floor plate;

15 a bottom pan disposed within said plenum, said bottom pan substantially in the shape of an inverted bowl and having at least one hole therein; and

20 a reformat outlet extending from said floor plate into said plenum in the region defined by the cooperating surfaces of said bottom pan and said floor plate.

34. The reformer of claim 33 wherein said catalyst bed comprises catalyst pellets.

25 35. The reformer of claim 33 wherein said catalyst bed comprises a foam support.

36. The reformer of claim 33 wherein said catalyst bed comprises a metal foam support.

30 37. The reformer of claim 36 wherein said metal foam support comprises a FeCrAlY alloy.

38. The reformer of claim 33 wherein said reformer tubes further comprise at least one stabilizer member connected to said inner gas return tube and interposed between said outer tube
5 and said inner gas return tube.

39. The reformer of claim 38 wherein said at least one stabilizer member comprises at least one annular perforated plate extending radially from said inner gas return tube.

40. The reformer of claim 38 wherein said at least one stabilizer member comprises at least one fin extending axially from said inner gas return tube.

41. The reformer of claim 33, further comprising a vaporizer disposed within said vessel for receiving and vaporizing a stream comprising water.

42. The reformer of claim 41 wherein said vaporizer comprises a finned tube helical coil.

43. The reformer of claim 41 wherein said vaporizer comprises a corrugated tube helical coil.